

## Technology Evaluation for Environmental Risk Mitigation Principal Center



### Lead-Free Solder Body of Knowledge

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NASA's Electronic Parts and Packaging (NEPP) group directed ITB to develop a body of knowledge on lead-free solder. This effort, contracted through Marshall Space Flight Center, centered on preparing a guidance document to assist NASA in determining areas of risk associated with Class III high reliability electronics. The document would serve to help NASA with the transition to lead-free by analyzing lead-free test programs, university lead efforts and supply issues associated with lead-free. ITB completed this project in the summer of 2005.

Currently there is not enough high-reliability (IPC Class 3) data to understand how lead-free materials will behave under the harsh environments of space applications. There are too many variations with lead-free materials including board finishes, part finishes and solder alloys. Process and performance reliability is tied the selection of lead-free materials for specific applications. Further complicating the issue is the fact that process and performance reliability can vary greatly for the same product supplied by different vendors.

The following risk mitigation strategies are proposed:

1. Ensure that everyone, from Procurement to Logistics to Technicians, understands the issue and concerns of lead-free solder and parts that may contain lead-free solder. Making it everyone's responsibility will reduce the risk of component or system failure from the use of lead-free solder.
2. Identify what part manufacturers and suppliers are doing; which are converting to lead-free, which are going to have two lines, and what controls will be in place to prevent mix-ups.
3. Modify logistics systems to capture all possible methods of identifying lead-free products by modifying inventory system to flag lead-free, RoHS compliant and "Green" products. Be prepared to conduct a physical inventory for products not changing part numbers
4. Implement internal procedures to deal with issues of lead-free product re-labeling and non-lead-free return processes. Clearly defined labeling and parts numbers need to be created for each product to differentiate it from its leaded counterparts. If the OEM refuses to make such a differentiation, then the local NASA Quality Assurance (QA) departments will have to work with technicians requesting the purchases to ensure that some sort of post-purchase/post-delivery identification system is set up to keep the leaded parts separate from the lead-free parts.
5. Continue participation in efforts such as CALCE, CAVE, and JCAA/JGPP Lead-Free Solder.

The NASA TEERM Office is continuing to get the word out on the Lead-Free Solder (LFS) Body of Knowledge (BOK). The NASA TEERM Office has been successful in getting the BOK report on NASA websites. With the report on the NASA websites, anyone within the agency with an interest in LFS can obtain access to the report and the valuable information contained within it. The data gaps identified within the BOK will serve as starting points when discussing new lead-free (LF) projects which are needed in order to fully understand the reliability of lead-free electronics possibly operating in space environments. The NASA TEERM Office will continue to support developing efforts related to LF electronics as the NASA agency faces the impending transition.

The LFS Body of Knowledge final report and associated appendices is available on the NASA Electronics Parts and Packaging (NEPP) Program: <http://nepp.nasa.gov>